Center Independent Research & Development: JPL IRAD

Hybrid Rockets for CubeSats (HRC)

Completed Technology Project (2015 - 2018)

Project Introduction

This task will develop the first interplanetary 12U CubeSat hybrid rocket propulsion system. The hybrid rocket propulsion system will utilize green propellants, enjoy high performance (goal of Isp >300 s) and be capable of relatively large delta velocities (~1km/s) representative of planetary orbit insertions. This second year will enable flight-like testing of the system components including the longest duration burn (>60 s) of a hybrid using oxygen. This will be the most capable CubeSat propulsion system to date and will enable several conceptual Planetary Science missions such as the Venus and Phobos Explorers.

The goal of this effort is to develop a prototype hybrid rocket motor that will be ready for infusion into a flight project at the end of this 3-year task. Toward achieving this goal, two crucial research objectives were completed in year 1 (FY16) of this 3-year effort.

Objective 1: Quantify hybrid rocket performance for CubeSat-sized motors.
Objective 2: Size a hybrid rocket motor with 300s, Isp and ~1km delta-V that fits within a 12U CubeSat form factor.

The quantitative goal of this effort represents a substantial increase in CubeSat propulsion capability and is the following: demonstrate an Isp of >300 s for a CubeSat-sized hybrid motor.

Anticipated Benefits

It will enable interplanetary CubeSat missions by providing nearly 1 km/s of delta-V. It will also advance the maturity of in-space hybrid propulsion technology for future applications, including a potential Mars Ascent Vehicle.

This technology project will prepare a propulsion system with about 1 km/s of delta-V capability for infusion into CubeSats (commercial or NASA).

Developing in-house hybrid propulsion capabilities for Planetary CubeSats will enable low cost, ride share payloads with significant science return. Several small propulsion systems have been designed for CubeSats in the past; however, most remain at low performance (40-250s, Isp) or low TRL. There are currently no systems available to deliver the delta-V required for planetary orbit insertions. This development effort will integrate multiple starts into a compact hybrid motor design, thus enabling a new class of stand-alone, interplanetary small sat missions.

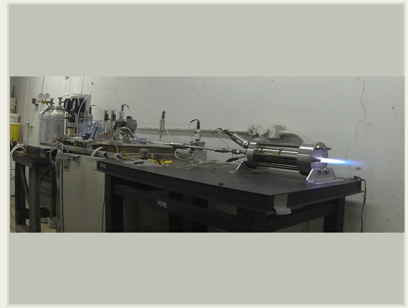

Image from one of the hot fire tests.

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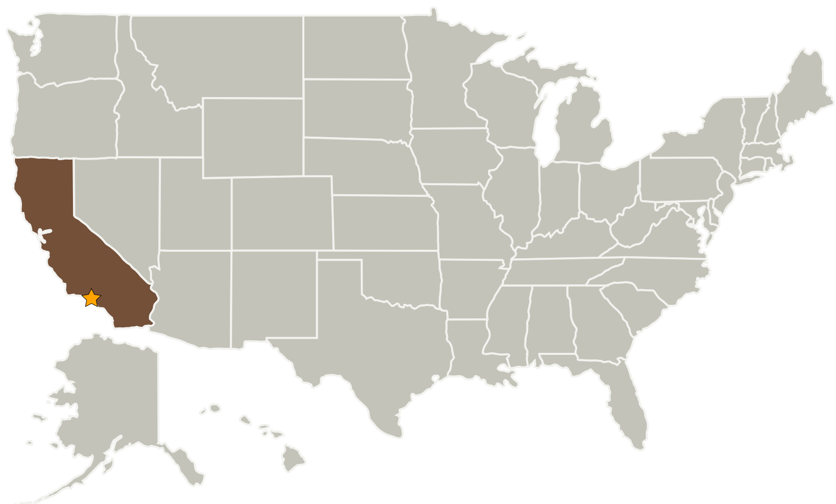
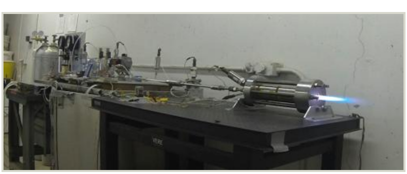
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
California

Images



Hot Fire Test
Image from one of the hot fire tests.
(https://techport.nasa.gov/image/26030)

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

Center Independent Research & Development: JPL IRAD

Project Management

Program Manager:

Fred Y Hadaegh

Project Manager:

Fred Y Hadaegh

Principal Investigator:

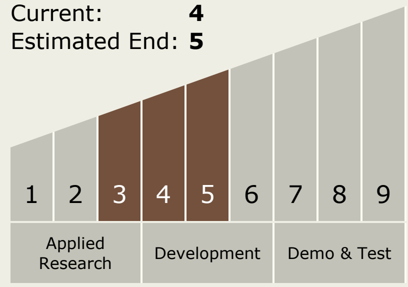
Ashley C Karp

Co-Investigator:

Elizabeth T Jens

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **5**



Technology Areas

Primary:

- TX01 Propulsion Systems
  └ TX01.1 Chemical Space Propulsion
    └ TX01.1.5 Hybrids

Target Destinations

Others Inside the Solar System, Foundational Knowledge

Supported Mission Type

Push